Claims

1. Image processing system for generating a multidimensional adaptive oriented filter to be applied to the point intensities of an image formed in a number d of dimensions, comprising:

processing means for producing, from the image point intensities [I(x)], adaptive oriented filter coefficients [w(r)] formed through combination (Π) of weighted scalar coefficients [$w_1(r)..w_i(r)...w_d(r)$], which coefficients are weighted scalar products [$w_i=f_i(<e_i . r>)$] of a number d of vectors ($e_1...e_i...e_d$) of an oriented vectors basis, by a number n of local vectors (r) estimated over a neighborhood [N(x)] around the current image point.

2. Image processing system of Claim 1, comprising:

product means for producing the weighted scalar coefficients [$W_1(r),..,W_i(r),..,W_d(r)$];

combination means (Π) for combining the weighted scalar coefficients to produce a set of one-scalar weight coefficients [W(r)] forming the adaptive oriented filter kernels; and

filtering means (g) for producing filtered image data [g(x)] from the combination of the image data [I(x+r)] over the neighborhood [N(x)] with the one-scalar weight coefficients [W(r)].

3. The system of one of Claims 1 or 2, comprising:

a direction estimator (10) for providing, at each image point, an oriented orthogonal basis of a number d of vectors ($\mathbf{e_1}$-$\mathbf{e_d}$);

a site generator (20) for providing n site vectors forming a neighborhood [N(x)] of the image points; and

product means for computing a number d of scalar products [$<e_i . r>$] of the vectors of the orthogonal vector basis for each of the n site vectors (r), for each image point.

4. The system of one of Claims 1 to 3, comprising:

weighting means for weighting the scalar products [$<e_i . r>$] through scalar functions (f_i).

5. The system of one of Claims 1 to 4, comprising:

filtering means including a weighted normalized sum of the products of image data [I(x+r)] over the neighborhood [N(x)] of the image points by the one-scalar weight coefficients [W(r)] forming the adaptive oriented filter kernels.

6. The system of one of Claims 1 to 5, wherein:

the combination means (Π), for producing the set of one-scalar weight coefficients [W(r)] forming the adaptive oriented filter kernels, is a d-terms product.

7. The system of one of Claims 1 to 6, wherein:

the direction estimator (10) for producing the vectors of the oriented vector basis includes direction estimation means for estimating direction of image features based on gradient estimation or eigen vectors of Hessien or of tensors of structure.

8. The system of one of Claims 1 to 7, comprising:

weighting means for producing the weighting functions chosen among Gaussian functions and/or symmetrical functions whose output is positive for values near zero inside a canal and is negative each side of the canal beyond the canal.

9. The system of one of Claims 1 to 8, comprising control means for the user to select image oriented features to be processed through the direction estimator (10) and/or the type of neighborhood [N(x)] for the Site Generator (20).

10. The system of one of Claims 1 to 9, comprising control means for the user to choose the shape of the weighting functions (f_i), for selecting the amount of filtering, which corresponds to positive coefficients, and for selecting the amount of enhancement, which corresponds to negative coefficients.

11. Image processing method for generating a multidimensional adaptive oriented filter to process image data in a number d of dimensions, using a system as Claimed in one of Claims 1 to 10, comprising steps of:

computing, from the image point intensities [I(x)], adaptive oriented filter kernels [w(r)] formed through the combination (Π) of weighted scalar coefficients $[W_1(r)..W_i(r)...W_d(r)]$, which coefficients are weighted scalar products $[W_i=f_i(<\mathbf{e}_i \cdot \mathbf{r}>)]$ of a

number d of vectors of an oriented vectors basis ($e_1 ... e_i ... e_d$), by a number n of local vectors (r) estimated over a neighborhood [N(x)] around the current image point;.

filtering (g) the image data [I(x+r)] by the adaptive oriented filter kernels [w(r)] for producing filtered image data [g(x)] over the neighborhood [N(x)].

12. Medical examination apparatus comprising means to acquire d-dimensional image data [I(x)], a system as Claimed in one of Claims 1 to 10 and further comprising a display system (154) for visualizing processed images and user control means (158) for selecting weighting functions and/ or acting on the direction estimator and/or the site generator.

13. A computer program product comprising a set of instructions for carrying out the method as claimed in Claim 11.